

Importance of Recognition of Osteoporosis and the Radiologic Diagnosis Using DEXA Technique

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Abstract

Objective: Osteoporosis is the most common bone disease in humans; It is widely recognized as an important public health problem because of the significant morbidity, mortality and costs associated with its complications. The main objective of this study is to assess the osteoporosis disease and bone mineral density (MBD) in adults and menopausal patients and to estimate that osteoporosis can be prevented, diagnosed and treated before any fracture occur.

Methods: This study was conducted in order to an intense effort to better recognition and understanding of osteoporosis disease and the importance of the medical radiologic diagnosis to preventing of osteoporotic fractures, using radiologic tools Dual energy x-ray absorptiometry (DEXA). Population of the study including male and female patient's age 18 years and older, whom underwent (DEXA) exam in period from September 2016 to March 2017.

Results: The main results a proved that osteoporosis can be prevented, diagnosed and treated before any fracture occurs by using BMD test. The prevalent of osteoporosis reach 86 out of 136 scanned patients with DEXA with percentage (63.3%) with the score -2.5 or lower. Others results achieved that the big distribution an effected by osteoporosis were found in the elder age over 50 years. The results also achieved the common risk factors associate with postmenopause with percentage of 43.0% and the common patient's risk of fracture occur in the lumbar spine by percentage of 45.4% a according to their T score.

Conclusion: Although for many years there was awareness of the morbidity and mortality associated with fragility fractures, real progress only came with the ability to diagnose osteoporosis before fractures occur.

Keywords: Osteoporosis; Radiologic diagnosis; Imaging techniques; DEXA; BMD

Introduction

Osteoporosis is a disease in bone density and strength comes from 'osteo' meaning bone and 'por' a Greek word means porous bone [1]. It characterized by low bone mass and micro architectural deterioration of bone tissue predisposing to an increased risk of fracture. However, in the last few years the problem of Osteoporosis has been recognized as an important public health issue, it can be present for years without any noticeable symptoms or signs of the disease until a bone fractures. For this reason, osteoporosis is often called "the silent thief", but sometimes signs of severe back pain, loss of height over time and bone fractures from minor injuries can be found [2,3].

Normal bone is composed of a mixture of calcium and other minerals such as magnesium and phosphate. It is also made up of collagen, which forms the structural framework of bone. The loss of mineral content of the bone is referred to as a loss of bone mineral density in the bone, so osteoporosis when progress over time, leads to thinning and deterioration of bone tissue with loss of calcification and density [4,5]. This can cause the bone to become fragile and break. The clinical diagnosis combines evidence of fragility fractures with measurement of bone mineral density (BMD). These is known as

minimal trauma fractures. People with osteoporosis most often break bones in the hip, spine and wrist. Many risk factors can lead to bone loss and osteoporosis disease such as gender, age, body size, family history, hormones, Anorexia nervosa, calcium and vitamin D intake, medication use, activity, smoking and alcohol are risk factors for the disease [6,7]. However postmenopausal women and men are also at risk for this disease. Peak bone mass is achieved in early adulthood between the ages of (18-25 years) and remains relatively stable until the onset of menopause. Menopause results in an increase of bone loss, which ranges from 3 to 7 percent in during the first 6 to 7 years post menopause. After this point, bone loss still occurs but at a much lower rate [8].

Calcium is lost from the bones due to menopause and aging. While most age groups have adequate calcium intake. This is a concern as these years are important in optimizing peak bone mass [9]. Early detection of bone loss is important to prevent osteoporosis fracture. A radiologic imaging technique provides the best means of both diagnosing fracture risk and tracking the progress of therapeutic intervention. There are many monitoring options available to diagnose and assess osteoporosis [10].

Bone densitometry (BMD) measurement devices that use absorption techniques, they first developed single photon absorptiometry (SPA) and dual photon absorptiometry (DPA), this devices used radionuclide sources and could quantitatively measure

the BMD of the peripheral bones, which have largely given way to dual energy x-ray absorptiometry or (DEXA) which represents the most widely used means of measuring bone density. It involves very low radiation exposure [11].

Single and dual – energy x-ray absorptiometry are used to assess mineral content of the entire skeleton and that of specific sites, including those most vulnerable to fracture. Bone mineral contents are the amount of mineral in the specific site scanned and when divided by that are measured, can be used to drive a value for BMD. Both techniques provide a two dimensional areal picture, rather than a true volumetric density, thus the size of the bone affects the apparent density, since the relation between area and volume is non-linear [12,13].

DEXA is a diagnostic tool for osteoporosis or osteopenia, where osteopenia is diagnosed when there is reduced mineral content in bone, but not as low as to be considered osteoporosis. The diagnosis test result measured by the T- score and Z-score, where the T-score compares the patient's bone density to the peak bone density of young adults. It is the number of standard deviations (SDs) of the BMD measurement above or below that of young healthy adults of the same sex. According to definitions agreed by the World Health Organization (WHO). At-score of -2.5 or lower at the spine or hip is indicative of osteoporosis and score between 1 and 2.5 SDs indicates osteopenia or low bone density. Normal bone density is no more than 1 SD below the young adult normal value (Figure 1). The Z-score score compares the patient's bone density to that of adults of the same age group. Z-score is a useful indicator of possible secondary osteoporosis. A Z-score of -2.0 or below should trigger investigations for underlying disease to exclude other causes of bone mineral loss [14].

There are many other radiologic technologies procedures which can be performed to determine bone injury or fractures due to osteoporosis, this procedures include CT scan of the spine or quantitative CT (QCT) to assess for alignment and bone fracture, it can be used to measure bone density and determine whether vertebral fractures are likely to occur. It allow for the separate assessment of trabecular and cortical densities within the same bone [15,16].

MRI of the spine is a magnetic resonance imaging of the spine is performed to evaluate vertebral fracture especially if there is evidence of severe narrowing of spinal cord in some cases of compression of fracture as a result of osteoporosis, when surgical treatment may be required [17]. Ultrasound technology is improving and may take significant inroads in this area. Technological problems still remain to be resolved in bone density ultrasonography, Quantitative ultrasound (QUS) is an alternative method introduced to evaluate skeletal integrity

At easily accessible peripheral sites and currently it is performed on the calcaneus, patella and forearm. Properties of the bone can be obtained by estimating and counting the differences between the sound waves transmitted into a bone and the wave emerging after interaction with the bone. The absence of ionizing radiation and the rapidity of examination in addition to cost savings may allow for QUS in widespread clinical use [18,19]. A number of radiographic and nuclear medicine techniques are also available for assessment of patients suspected of having osteoporosis or at risk for the development of the disease. In addition they can documented the presence of metastatic tumors or others lesions that may produce compression fracture [20,21].

The fact that the majority of BMD loss in osteoporosis patient s occurs before the first appearance of fracture, it is further supported by The National Osteoporosis Foundations [22], to taking in mind, the steps which reduce risk of osteoporosis such as: Consume adequate amounts of calcium and vitamin D, participate in weight- bearing and muscle strengthening exercise, eat foods that are good for bone health such as fruit and vegetables, avoid smoking and alcohol especially during menopause and for menopausal women it is necessary to assess whether or not hormone replacement therapy is needed [23,24].

There was consensus that for the population under consideration if 10 years probability of hip fracture is $\geq 3\%$ or the 10 years probability of major osteoporosis fractures is $\geq 20\%$, a diagnosis of osteoporosis can be made. The efficacy of many of the currently available therapies to lower fracture risk is based upon clinical trial in which entry criteria typically required BMD T-score of ≤ 2.5 at spine or hip and not fracture history or FRAX score. FRAX is a diagnostic tool used to evaluate the 10 years probability of bone fracture risk of osteoporosis fracture based on individual risk factors with or without BMD values [25,26].

Today, radiologic BMD measurements have an important role in the evaluation of patients at risk of osteoporosis and in the appropriate use of anti-fracture treatment.

In general the preferred radiologic method to diagnosis osteoporosis, is to use DEXA scans of the central skeleton to measure BMD of the lumbar spine and hip, according to the recommendations of (WHO) [27] is to use spine and hip BMD measurements in postmenopausal women, should be interpreted using WHO T-score definitions of osteoporosis and osteopenia. Central DEXA examinations have three major roles, namely the diagnosis of osteoporosis, the assessment of patient's risk of fracture and monitoring response to treatment [28].

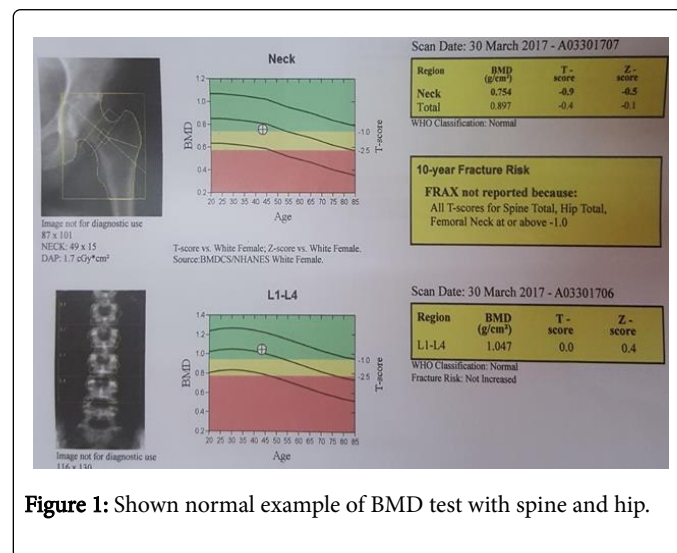


Figure 1: Shown normal example of BMD test with spine and hip.

Methods

The importance of this study comes from the important progress in the last 25 years, which has been made in both the diagnosis and treatment of osteoporosis. These efforts have led to actual reductions in fracture incidence although the real potential for benefit in this area has only been partially realized. In addition to the lack in awareness

and recognition on how to proceed in applying the radiologic diagnostic modalities which are available for BMD measurements.

The main objective of this study is to assess the osteoporosis disease and bone mineral density (MBD) in adults and menopausal patients, using radiologic tools DEXA. And the current study hypothesis that the radiological DEXA technique is the standard test for the diagnosis of low bone mass and estimated that, osteoporosis can be prevented and diagnosed before any fracture occur.

Scope and target population including all patients referred to do DEXA scan in Najran province, King of Saudi Arabia in period of September 2016 to March 2017.

The guideline including the diagnosis and management of 86 adult and menopausal patients suspected of osteoporosis whose undergo DEXA scan with different age and sex from (18 to 90 years old) and the data were analyzed using Microsoft excel.

For ethical consents, all ethical aspect for patients was carefully considered, and all requirements for authorship have been met. For research approval, the author declare that ethics committee approval has been obtained and for disclosure, the author declare that no conflict of interest.

Clinical highlight

Is to discuss and recognition osteoporosis risk factors, causes and prevalent distribution according to age and sex with patients suspected to develop the disease.

Results

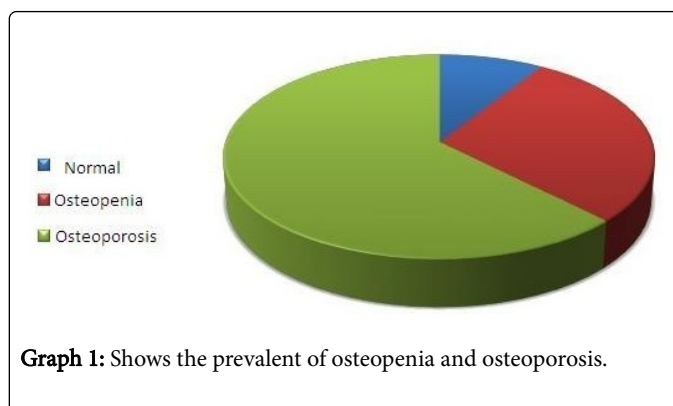
Concerning the assessment of osteoporosis disease and BMD in adult and menopausal patient using DEXA scan, which was conducted in 136 patients. The results obtained from records reports interpreted by radiologists were represented in tables and graphs. The first result concerning the prevalent of osteopenia and osteoporosis comparing to gender achieved that, (8.8%) of total of 136 scanned patient were normal (the Score average +1 or -1), were the patients with osteopenia is (27.9%) (The score -1 to -2.5) and 86 patients with percentage (63.3%) with osteoporosis (the score -2.5 or lower).

Groups	Patient No.			Total
	Normal	Osteopenia	Osteoporosis	
Female	8	32	72	112
Male	4	6	14	24
Total	12	38	86	136
Percentage	8.80%	27.90%	63.30%	100%

Table 1: Shows the prevalent of osteopenia and osteoporosis comparing to gender.

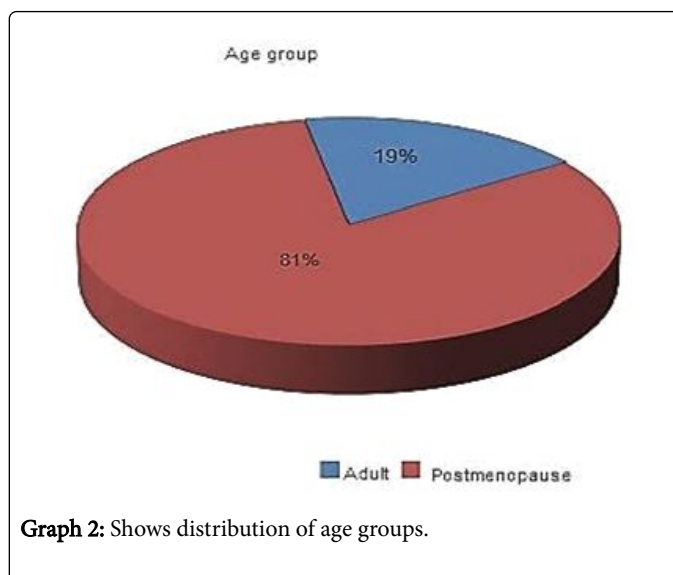
Age group	Percentage
Adult (18-50)	19%
Post menopause (50-90)	81%

Table 2: Shows distribution of age groups.



Graph 1: Shows the prevalent of osteopenia and osteoporosis.

Result obtained for age groups, achieved that the big distribution affected by osteoporosis were found in the elder age over 50 years.

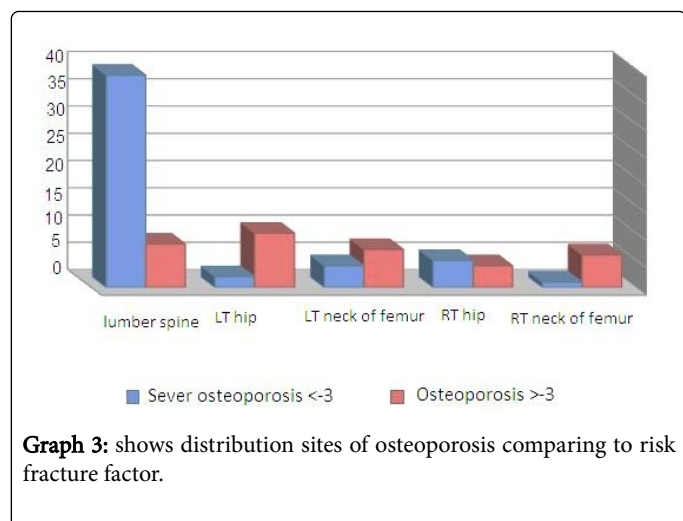


Graph 2: Shows distribution of age groups.

The result a according to distribution sites of osteoporosis comparing to risk fracture factor, achieved that ,the most common site to detect osteoporosis is the lumber spine by percentage of 45.4% a according to their T-score.

Fracture risk			
osteoporosis<-3 Frequency	Percentage	Osteoporosis>-3 Frequency	Percentage
39	45.40%	8	9.30%
2	2.30%	9	10.50%
4	4.70%	7	8.10%
5	5.80%	4	4.70%
2	2.30%	6	6.90%
52	60.50%	34	39.50%

Table 3: Shows distribution sites of osteoporosis comparing to risk fracture factor.

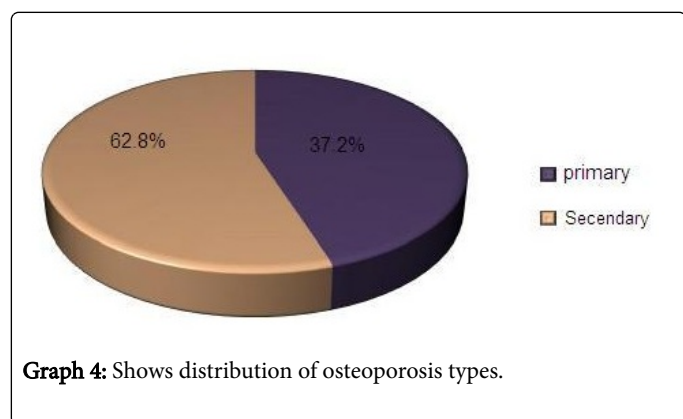


Graph 3: shows distribution sites of osteoporosis comparing to risk fracture factor.

Result obtained for distribution of the type of osteoporosis achieved that 37.2% is primary type associated with post-menopause risk factor. While 62.8% were Secondary types associated with others risk factors.

Percentage	Frequency	Type of osteoporosis
37.20%	32	Primary
62.80%	54	Secondary
100%	86	Total

Table 4: Shows distribution of osteoporosis types.

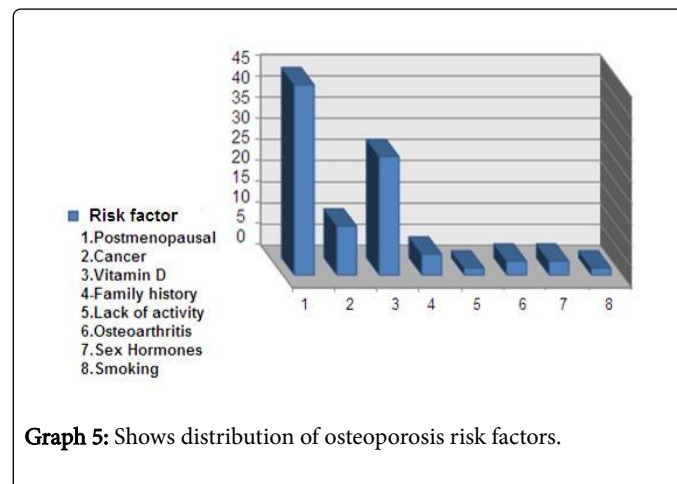


Graph 4: Shows distribution of osteoporosis types.

Risk factor	Frequency	Percentage%
Postmenopausal	37	43
Cancer (Ca)	9	10.5
Vitamin D deficiency	22	25.6
Family history	4	4.7
Lack of activity	3	3.4
Osteoarthritis (OA)	4	4.7
Sex Hormones	4	4.7
Smoking	3	3.4

Total	86	100%
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Table 5: Shows distribution of osteoporosis risk factors.



Graph 5: Shows distribution of osteoporosis risk factors.

Discussion

Osteoporosis is a silent disease leading to a major morbidity and mortality in the aging population around the world. And concerning the assessment of osteoporosis BMD in population of this study, the novel finding summarized in that the prevalent of osteoporosis is 86 out of total of 136 scanned patient with percentage of (63.3%), the score (-2.5 or lower). And (8.8%) of the population were normal with average Score (+1 or -1). The osteopenia patients prevalent is (27.9%) with average score (-1 to -2.5). The first result concerning the prevalent of osteopenia and osteoporosis represented in (Table 1 and Graph 1). Others results achieved that the big distribution affected by osteoporosis was found in the elder age over 50 years. The results also achieved the common risk factors associate with postmenopause with percentage of 43.0% and the common patient's risk of fracture occur in the lumber spine by percentage of 45.4% according to their T score.

In comparing results of the total number of male and female, the gender distribution reflect that the higher percentage of the disease associated with women, were 72 women's with percentage of (83.7%) opposite 14 men with percentage of (16.3%). Bone mineral density test is recommended based on age and risk factor states in both men and female, these was written in a general reports on both health and osteoporosis as well as others guidelines [14,22,27], which agreed with the result found in our study concerning age group (Table 2 and Graph 2), which achieved that the big distribution for osteoporosis were found in elder patient over 50 years. This population is the same as that included in the National Osteoporosis Foundation (NOF) Clinician's guide (2012), which recommended BMD testing for women aged 65 years and older, also recommended BMD testing for postmenopausal women and men aged 50-70 years old with high risk profile.

In study conducting by Hannan and Felson [29], they found that BMD fell with age in both elderly women and men. But the average 4 years BMD loss for women (range 3.4-4.8%) was greater than the loss for men (range 0.2-3.6%).

The result according to distribution sites of osteoporosis comparing to risk fracture factor (Table 3 and Graph 3) achieved that the most common site to detect osteoporosis is the lumber spine

by percentage of 45.4% a followed by right hip according to their T-score. On the other hand many previous studies reported that the common site of osteoporosis fracture is the hip joint, but for recent study it found that the lumbar fracture is the common site, this may be limited to the few number of population but also this result were approved with the categories have been proposed by (WHO) and modified by the international osteoporosis foundation, for assessment done with DEXA Were it proposed for sever osteoporosis hip or spine BMD 2.5 SD or more below the young adult mean in the presence of one or more fragility fracture. Therefore a recommendation was made to formally expand the criteria for allowing a diagnosis of osteoporosis to include the presence of certain low-trauma fractures or the determination of an elevated fracture risk using FRAX, without a T-score of -2.5 or lower. The result finding in this study also were agreed with other previous study which state that osteoporosis were more common in individuals above 50 age and the lumbar spine is the common site affected by the disease [30].

Result obtained in recent study for distribution of the main types of osteoporosis (Table 4 and Graph 4) achieved that 37.2% is primary type, most associated with post-menopause risk factor. While 62.8% were secondary types associated with others risk factors. These factors represented in (Table 5 and Graph 5) shown the most risk factors that were associated with osteoporosis, which include postmenopausal with percentage of 43%, fragility post exposed to cancer with percentage of 10.5%, deficiency in calcium and vitamin D intake with percentage of 25.6%. Others factors include, family history, sex hormones and affected with others bone disease such as osteoarthritis all with same percentage 4.7%, while factors such as lack of activity and smoking, also with same percentage 3.4%. These results approved with previous study conducted in 2014 by Oommen and Alzahrani [31], whom demonstrated the prevalence of osteoporosis and factors associated with osteoporosis women, the study found a correlation between affected with osteoporosis and in sufficient of many factors associated with nutrition and growth development in childhood such as calcium, along with enough protein and vitamin D. The peak bone mass that is achieved varies from one individual to the next and primarily reflects what has occurred during growth and development in childhood and adolescence. It is also influenced by genetic factor as well. Hence an individual who has adequate intake of vitamin D, Calcium. Plenty of exercise and not been subjected to any sex hormone deficiencies, or certain others bone disease, will likely to achieve a high peak bone mass [31].

Bone density testing is recommended based on age and risk factor status in both men and women by WHO and others guidelines [32]. Many who receive the test may still not be recognized having an elevated fracture risk, because their scores reflect osteopenia which in some instances does indicate high risk based on elevated age or prior fracture history or other validated risk factors. Prior fracture affords the highest risk for future fracture, yet an older patient with a hip fracture may not be diagnosed as having osteoporosis unless the patient has a BMD test with T score of ≤ -2.5 and the majority of hip fracture patients have T scores that better than -2.5 [33].

Conclusion

Although for many years there was awareness of the morbidity and mortality associated with fragility fractures, real progress only came with the ability to diagnose osteoporosis before fractures occur. Yet the author recommended for the term osteoporosis is not formally applied unless there is certain low trauma fracture, because a greater number

of people have osteopenia than osteoporosis as defined by BMD. And we support the continued use of BMD testing and the finding of a T-score of ≤ -2.5 at the spine or hip as one way to make the proper diagnosis.

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